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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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TITLE: DOMED PACKING MATERIAL

SPECIFICATION

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to packing materials for use in cushioning items, and more specifically to a packing material having a plurality of layers of material which nest to take a minimal amount of space prior to use, but which layers can be pulled apart and disoriented to take up a large amount of space to function as a packing material.

RELATED ART

In the past, there have been many attempts to provide packing materials for positioning around items to be shipped in containers, boxes or otherwise. Crumpled newspaper is one such packing material that is and has been in widespread use. Shredded paper is another such material. These materials suffer from moisture absorption and provided limited elastic cushioning. Another common material is plastic "bubble wrap," trademarked "BUBBLE WRAP" by the Sealed Air Corporation and which consists of PHS 6/26/00 a lower layer and an upper layer with numerous air bubbles formed therebetween for holding air. This packing material is very useful because it is very light in weight. However, one particular problem with bubble wrap material, which has not been overcome is the fact that even when it is not in use, it still takes up a large amount of space. Bubble wrap material is bulky and space consuming through its entire life -

from manufacturing, shipping, storage on distributor and retail shelves, in homes or factories before use and lastly during its disposal. Because of the large continual space requirements, individuals, businesses, and others may be reluctant to purchase and store this material.

Various other types of packing materials have also been invented and used, including, pellets made of styrofoam or other materials, shells made of styrofoam, etc. Another material used for packing is embossed paper. Again, as with the bubble wrap, a common problem among all of these materials is that they are bulky during their entire life.

Other efforts in this and related areas include the following:

U.S. Patent No. 5,538,778 to Hurwitz, et al., which discloses a cushioning material for packing in the form of an expanded paper material which can be shipped in an unexpanded form and expanded prior to use. It is designed with a plurality of slits and then pulled to form hexagonal cells.

U.S. Patent No. 4,518,643 to Francis, discloses a plastic film having a permanently embossed design or geometric shape for controlling the coefficient of friction between adjacent sheets of film.

U.S. Patent No. 3,575,781 to Pezely, discloses a plastic film wrapping material formed with hemispherical protuberances thereon. These sheets will not nest tightly stored on each other.

U.S. Patent No. 3,231,454 to Williams, discloses a cushioning packaging material formed of either one or two sheets having a plurality of hollow projections extending from one side of the sheet in the same direction. When a bottom surface is utilized, a vent is provided in the projections to allow air to escape. Again, this material will occupy much space prior to use.

Others works, in related areas, include: U.S. Patent No. 2,285,335 to Hurt; U.S. Patent No. 5,201,154 to Thomas; U.S. Patent No. 3,940,811 to Tomikawa, et al.; U.S. Patent No. 3,911,187 to Raley; U.S. Patent No. 3,525,663 to Hale; and U.S. Patent No. 3,484,835 to Trounstine, et al.

What has not been previously developed, and what would be highly desirable, is for a packing material that takes up the smallest possible amount of space prior to use, but provides bulk and elastic cushioning when in use. The present invention achieves this, as will be hereinafter described. It is believed that nothing prior hereto has been successful in achieving this, and that none of the previous work of others teaches or suggests all of the aspects of the present invention.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a packing material that takes up a minimal amount of space prior to use, but which can then be converted into a bulky, elastic cushioning packing medium.

It is a further object of the present invention to provide a packing material having domes formed in a substrate.

It is an additional object of the present invention to provide a packing material comprising a plurality of sheets of materials with corresponding domes formed therein, which domes nest completely prior to use.

It is even an additional object of the present invention to provide a domed packing material having a plurality of layers which, when separated and disoriented, take up a large volume of space because of the domes therein.

It is even an additional object of the present invention to provide a packing material comprising a plurality of layers with domes of various sizes and shapes and directions formed therein.

It is even an additional object of the present invention to provide a packing material having a plurality of layers with domes formed therein, wherein the pattern of domes is varied to prevent re-nesting of the layers after they are disoriented.

It is an additional object of the present invention to provide methods for manufacturing the dome packing material of the present invention.

It is a further object of the present invention to provide a packing material that minimizes space and costs associated with shipping, storage, the display thereof for sale and its disposal.

It is an additional object of the present invention to provide a method for manufacturing a packing material that is inexpensive.

It is an additional object of the present invention to provide a method for continuous manufacturing of a packing material.

It is an additional object of the present invention to provide a method for manufacturing a packing material that is capable of being assembled into small units convenient for the display and sale thereof.

It is an additional object of the present invention to provide a method for manufacturing a packing material that is capable of being assembled in standard size boxes for sale and display.

The present invention relates to a packing material having a plurality of domes formed therein. The domes can be formed in more than one direction and can be of different sizes. A plurality of layers of a pliable plastic material are placed together to form a composite material, and domes are formed in the composite material. Thereafter, the composite material can be cut

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or torn to desired sizes or shapes. Importantly, the domes formed in the layers are ~~tighter~~ tightly nested and accordingly, the packaging material takes up the smallest possible space after same is manufactured. This serves to minimize the expense and space requirements for storage and shipping and disposal. In use, one separates the layers of the composite materials, and disorients same, and utilizes the layers for a packing material. Importantly, it is preferable that the domes are sized or shaped and positioned to tend against re-nesting. Methods of making the material are also set forth.

BRIEF DESCRIPTION OF THE DRAWINGS

Other important objects and features of the invention will be apparent from the following Detailed Description of the Invention taken in connection with the accompanying drawings in which:

FIG. 1 is a partial perspective view of the domed packing material of the present invention having a plurality of domes of different shapes and directions formed in a plurality of tight layers.

FIG. 2 is a cross-sectional view of a dome in the packing material shown in **FIG. 1**.

FIG. 3 is a cross-sectional view of a plurality of domes taken along line 3-3 of **FIG. 1**.

FIGS. 4, 5, 6, 7, and **8** are perspective views of a substrate for forming a plurality of layers of packing material by folding one sheet in a plurality of directions, and then processing the sheet to form domes therein, and subsequently unfolding the assembly.

FIG. 9 is a schematic view of a method of forming the domed packing material of the present invention.

FIGS. 10A-10D show steps for another method of forming the domed packing material of the present invention.

FIG. 11 is a schematic view of another method of forming the domed packing material of the present invention.

FIGS. 12A and **12B** show prior art materials wherein adjacent layers do not fully nest.

FIG. 13 is a diagram of a potential scheme of domes formed in layers according to the present invention designed to prevent re-nesting of the layers once the layers are disoriented.

FIGS. 14 and **15** are side views of a dome scheme designed to prevent re-nesting of adjacent layers after same are disoriented.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a packing material having a plurality of domes formed in multiple assembled layers of material. A plurality of sheets are stacked together and then domes are formed in the assembly such that the domes nest completely. This results in a packaging material that takes up a minimal amount of space prior to use. In use, the layers are separated and disoriented to create a packing material that is bulky and elastic. It is preferable that the domes are varied in size and direction to prevent re-nesting of the layers after they are separated and disoriented.

Referring to **FIG. 1**, a partial perspective view of the domed packaging material, generally indicated at **20**, is shown. As can be seen, in this view, there is a lower layer generally indicated at **20A** and an upper layer generally indicated at **20B**. Each layer comprises a film having a thickness in the area of .005-.015 inches. A plurality of layers such as five or six, or more, can be utilized. As can be seen, the packaging material **20** includes a generally flat portion **34** and a plurality of domes **30** extending in various directions, i.e. up dome **30A** or down dome **30B** in a plurality of sizes such as small dome **30C** and large dome **30D**. The variation in dome size and direction serves to prevent the re-nesting of sheets of the packaging material **20** after same are separated. Domes of one size, two sizes, or many sizes and shapes can be used, as desired. Likewise, the domes can extend in one direction or both directions. As can further be seen in viewing **FIG. 1**, the two layers **20A** and **20B** take up a minimal amount of space as same are nested together. By "nesting" it is meant that there is no air space between the adjacent layers **20A** and **20B** at the flat portion **34**, as well as at the domes **30**. In use, as will be hereinafter discussed, after layers **20A** and **20B** are separated and disoriented, the domes **30** and

the respective layers **20A** and **20B** serve to separate the layers **20A** and **20B**, and take up a much larger amount of space to function as a packing material.

FIG. 2 is a cross-sectional view of a dome **30** of the domed packing material **20**. The flat portion **34** of the domed packing material **20** is also shown. The flat portion **34** has a thickness of T, which tapers to a thickness of t at an upper portion of the dome **30**. This difference in thickness of the material comprising the dome **30** is accounted for by the stretching associated with forming a dome **30** in the domed packing material **20** which is formed of a polymeric material and stretches during the dome formation process. Additionally, the dome has a height H, a diameter W. Finally, the dome **30** extends from the flat portion **34** at an angle indicated at θ. The angle θ can clearly be varied as desired. Indeed, the shape of the domes **30** can be varied from dome shapes to any other shape such as pail shaped, square, star shaped, elongated, etc., as desired. However, angles of 45 degrees or less are thought to provide the necessary structural compression resistance.

FIG. 3 is a cross-sectional view of the packing material shown in **FIG. 1** taken along line 3-3. As can be seen, the domed packing material **20** includes large up dome **30A**, and smaller down dome **30C**. Flat portion **34** is also pictured. As previously set forth in describing **FIG. 1**, the domed packing material **20** as shown includes a lower layer **20A** and an upper layer **20B**. Additional layers would normally be formed at the same time. Up dome **30A** has a diameter W, and a height of H for each layer **20A** and **20B**. For domes to nest completely, each successive dome needs to be smaller, or respectively larger. An unexpected observation is that the change in size affects the side-to-side diameter, but not the height. It is believed that suitable heights H

for the domes are approximately $^1/_8$ to $^5/_{16}$ of an inch, but this can be varied as desired. Further, each layer **20A** and **20B** has a thickness T along the flat portion **34** (on the order of .009 inches thick) and a thickness t at an upper portion of the dome **30A**. T is greater than t (t may be about 30% less than T) based on the stretching that occurs during formation of the dome **30**. Similarly, small down dome **30C** had a diameter w and a height h. The height h of the dome **30C** is the same for both layers **20A** and **20B**. Also, there is a difference between the thickness T of the base **34** and the thickness of the small down dome **30C** at a mid-portion thereof, again caused by the stretching that occurs during dome formation.

Because the layers are formed together as one single assembly, each dome will be a slightly different shape so that all stacked domes will necessarily nest absolutely tightly.

Referring now to **FIGS. 4-8**, a method of forming a plurality of layers from a single substrate, for forming domes therein, is disclosed. First, as shown in **FIG. 4**, a sheet of material **40** includes a longitudinal fold line **42** which divides the sheet into first half **44** and second half **46**. Referring to **FIG. 5**, when the sheet **40** is folded in direction of arrow F to position the second half of the sheet **46** over first half of the sheet **44**, the sheet becomes half size. A first lateral fold line **50** and a second lateral fold line **52** are provided to divide the sheet **40** further into upper portion **54**, middle portion **56** and lower portion **58**. Referring to **FIG. 6**, upper portion **54** can be folded onto middle portion **56** along fold line **50** in a direction shown by arrow G and thereafter, lower portion **58** can be folded over upper portion **54** in the direction of arrow H to fold the substrate **40** to a panel having one-sixth of its original size.

Thereafter, as shown in **FIG. 7**, the folded material can be processed to form domes **30** in substrate **40** in accordance with the teachings of the present invention. Thereafter, the sheet can be unfolded as shown in **FIG. 8** and portions **60** with domes **30** can be separated from the sheet **40** for use. Alternatively, the sheet can be re-folded, along different fold lines than those already provided to effectively disorient the domes **30** such that the material generally takes up a large amount of space. Alternatively, more than one panel **60** can be utilized together to function as packing material. Importantly, the product shown in **FIG. 8**, if, for example, the substrate **40** is a eight and one-half by eleven inch assembled sheet, or other standard size, it can be easily packaged in a standard office box or other convenient package and can be easily stored, displayed and purchased because it does not take up a large amount of space and can be easily handled in a manner similar to the way other packages of similar sizes are handled. Accordingly, the nested packing material of the present invention can be provided in a compact package desirable to the retailer and consumer.

Referring to **FIG. 9**, another process for manufacturing the domed packing composite of the present invention is presented. As can be seen, a plurality of rolls **70** of substrate material such as plastic sheets **72** are provided. Sheets **72** are fed into a first roller **74**, where the sheets are put together to form a composite sheet, and then to a second roller **78** which serves to feed the composite sheet **76** formed by the plurality of layers **72**. The composite sheet **76** is then fed into processing station **80** where domes are formed in the material to provide a domed sheet **82**, which is again fed through third rollers **84** to pull the domed sheet **82** from the processing station **80** and feed the domed sheet **82** to a cutting station **86** wherein the domed sheet **82** is cut into desired sizes for packaging.

FIG. 11 shows another embodiment of a manufacturing process according to the present invention wherein a plurality of rolls, generally indicated at **170**, of plastic sheets **172** are fed to a first roller **74** which combines the sheet into a composite sheet **176** which is then fed through textured rollers **180** which forms domes in the material to produce a domed sheet **182** which is then fed through a tensioning second roller **184** and then fed to cutting station **186** or, which can be packaged into rolls **190**.

Referring now to **FIGS. 10A-10D**, a series of processing steps is shown in connection with a batch method of manufacturing the dome packaging material of the present invention. As shown in **FIG. 10A** a substrate **90** is fed into a press, generally indicated at **100** in a direction shown by arrow J. The substrate **90** can include a plurality of layers such as lower layer **90A**, middle layer **90B** and upper layer **90C**. The press **100** includes an upper press **110** and a lower press **120**. The upper press **110** includes an upper clamping plate **112** that is driven by clamping pistons **114** and dome ejector **115**. The upper press **110** further includes dome die **116**, dome die plate **118**, and dome dye piston **119**. The lower press **120** includes a fixed lower base clamp plate **122**, a dome ejector **125**, lower dome die **126**, dome die plate **128** and dome die plate piston **129**. Die domes **116** and **126** preferably have rounded edges to stretch but not pierce the substrate **90**.

As shown in **FIG. 10B**, the substrate **90** is maintained between upper and lower clamp plates **112** and **122** respectively by actuating clamp pistons **114** to move the upper clamp plate **112** in the direction shown by arrows K to sandwich the substrate **90** against the fixed lower base clamp plate **122**.

Referring to **FIG. 10C**, after the substrate **90** is retained between upper and lower clamp plates **112** and **122** respectively, the upper and lower dome die plates **118** respectively are

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engaged by actuating dome ~~dye~~ pistons **119** and **129** respectively to force dome dies **116** and **126** in the directions shown by arrows L, against the substrate **90** and into receptacles **113** and **123** (**FIG. 10B**) of clamp plates **112** and **122** respectively, to deform the substrate **90** to form domes **30** therein. Importantly, it is desirable that the receptacles **113** and **123** have angled or rounded edges **113A** and **123A** (**FIG. 10D**), respectively, to allow the substrate **90** to slide and stretch instead of breaking.

FIG. 10D shows the separation of upper and lower presses **110** and **120** in the directions of arrow M which allows for the substrate **90** with domes **30** to be removed from the press. Importantly, dome ejectors **115** and **125** may be needed to fully eject the domes **30** from the receptacles **113** and **123**. The dome ejectors **115** and **125** could be air conduits and a blast of air in the direction shown by arrows N would be sufficient to disengage the domes **30** from the receptacles **113** and **123**. Importantly, as can be seen, the layers forming substrate **90**, and the domes **30** formed therein, are completely nested. In use, the layers forming substrate **90** are separated and disoriented to provide a packing material that takes up a large volume of space.

FIGS. 12A and **12B** show protuberances formed in substrates according to the prior art. Previously, various substrates are separately manipulated to form identical domes. Such identical domes, cups or other protuberances can never nest completely because the outside diameter of the next dome can only fit to where the inside diameter of the previous one allows it. This results in air spaces, **26**, between the tops of the domes and between the substrates.

Consequently, the layers and protuberances of the prior art are at best "loosely stacked." This results in a bulky product that does not have all the benefits of the present invention, e.g. the nesting which permits the domed packaging material to occupy a minimal amount of space prior to use. Also, large sheets cannot be made by folding and forming and then unfolding.

FIG. 13 is a schematic diagram showing a key where 0 indicates a down dome and an X indicates an up dome. Thereafter, a pattern or algorithm of up and down domes is presented which is believed to provide a pattern that, after formed in a plurality of layers of a substrate, when the layers are separated and disoriented, it is believed that this pattern will tend to reduce the re-nesting of the layers. Importantly, any pattern or dome shapes that are non-repetitive would serve to decrease the likelihood of re-nesting. While any pattern of domes is considered to be within the scope of the present invention, the more non-repetitive, the better. As can also be seen with **FIG. 13**, besides varying domes from up and down, they can also be varied in positioning, i.e. they can be in front or behind, i.e. they can be aligned vertically (square) or diagonally to further decrease repetitiveness, and consequently, decrease the likelihood that separated layers will re-nest.

FIGS. 14 and **15** are side views of up and down or down only respectively, dome patterns made in accordance with the present invention wherein the domed patterns can be formed in adjacent layers for example, layer **120A** and **120B** in **FIG. 14** and layers **220A** and **220B** in **FIG. 15**. In a formed position, the layers have the same pattern of domes formed therein, but when the layers are separated and disoriented, the dome patterns tend to resist and prevent re-nesting and

serve to maintain the packing material in a condition wherein same takes up a relatively large space.

Importantly, the product of the present invention can be made utilizing a cold or thermoforming process, or in other ways known in the art. Also, the present invention is very suitable for use with recycled scrap polymeric materials as long as they are ductile when at heated or cold temperatures and flexible and elastic in their natural state. One example of an appropriate material is PETE (amorphous polyethylene terephth~~o~~alate). PS 6/26/00

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Importantly, ~~after use~~, one can easily dispose packing material after use in any desired manner. While packing material such as bubble wrap continues to occupy space after use, the domes of the present invention can be collapsed by the application of sufficient pressure.

Having thus described the invention in detail, it is to be understood that the foregoing description is not intended to limit the spirit and scope thereof. What is desired to be protected by Letters Patent is set forth in the appended claims.